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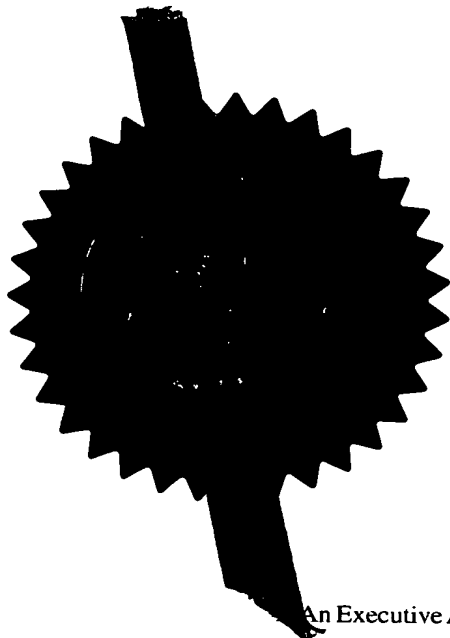
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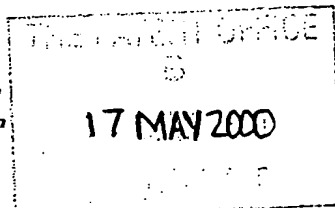
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P221962/PKE/BOU 17MAY00 5537352-2 B02884
E01/7700 0.00-0011752.3

2. Patent application number

(The Patent Office will fill in this part)

0011752.3

17 MAY 2000

3. Full name, address and postcode of the or of each applicant (underline all surnames)

Milliken Industrials Limited
Wellington Street
Bury
Lancashire
BL8 2AY
605618001
United Kingdom

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

"Method of Colouring Material"

5. Name of your agent (if you have one)

Murgitroyd & Company

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

373 Scotland Street
GLASGOW
G5 8QA

Patents ADP number (if you know it)

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1 **METHOD OF COLOURING MATERIAL**

2

3 The present invention relates to a new method of
4 colouring material, and especially to a new method of
5 dyeing woven or not woven material which provides the
6 material with an high visibility colour; to the dyed
7 material thus obtained and to the use of such
8 material in the manufacture of products to be used
9 for example in sports and especially in the covering
10 of tennis balls.

11

12 Traditionally, tennis balls were covered with a white
13 woollen felt. Several decades ago yellow felt was
14 introduced for use on match quality balls and from
15 the early 1970's balls covered with yellow felt
16 became increasingly popular. Today, the vast
17 majority of tennis balls are covered with yellow
18 felt. Rule 3 of the International Tennis Federation
19 Rules of Tennis states "The ball shall have a uniform
20 outer surface consisting of a fabric cover and shall
21 be white or yellow in colour..."

22

23 The felt used on tennis balls was previously made
24 from wool. Increased wear properties are obtained by
25 including a proportion of synthetic fibre in the
26 felt, and nowadays such felt is usually made of a
27 mixture of wool and nylon fibres. The proportions of

1 wool and synthetic used to produce the felt can vary,
2 but typically a ratio of 40:60 to 60:40 can be used
3 (by weight of weft yarn). It is desirable that the
4 side of the felt termed the "back" (which is the side
5 which will be stuck to the ball) is made of a
6 material which provides good adhesion when it is
7 glued on the internal rubber sphere of the ball.
8 Usually the backing is formed by using 100% cotton
9 warp yarns, but alternatives such as polyester and
10 nylon could be used.

11
12 The tennis ball felt is then preferably dyed with a
13 fluorescent dyestuff. That is, the coloured felt
14 will absorb ultra-violet light and re-emit the
15 absorbed energy in the visible area of the spectrum.
16 Most tennis balls are now covered with felt that is
17 dyed fluorescent yellow and which produces peak
18 reflectance values of over 100% in the yellow area of
19 the spectrum.

20
21 Few manufacturers produce fluorescent dyestuffs
22 suitable for both wool and polyamide fibres. To the
23 best of the Applicant's knowledge all the major
24 tennis ball felt manufacturers use the same class of
25 dyestuff albeit from different dyestuff suppliers.
26 This class of dyestuff gives a hue (colour) slightly
27 to the green side of yellow.

28
29 The cones in the human eye are mainly responsible for
30 daylight colour vision and these give the eye the
31 highest visual efficiency in the yellow wavelengths.

1 In addition to percentage reflectance three other
2 values can be plotted to identify a colour:

3

4 Lightness, with a scale of 0 to 100, 0 being black
5 and 100 white;

6

7 Hue, which can be shown as a circle with red at 0
8 degrees and yellow, green and blue at 90 degree
9 intervals from this, the exact angle therefore
10 indicating the hue. If the lightness is visualised
11 as a vertical axis passing through the centre of the
12 hue circle, then a colour can be plotted in three
13 dimensional space; and

14

15 Chroma or colour saturation which can be shown as the
16 distance along a given radius from the centre of the
17 hue circle.

18

19 In the mid 1990's a high visibility felt (or HVF) was
20 produced using an increased percentage of dyestuff.
21 This felt (or HVF) has a higher level of saturation
22 (Chroma) but actually has a slight reduction in peak
23 reflectance and in lightness when compared to some
24 standard coloured felt. A method has now been found
25 which allows the production of coloured felt for
26 tennis balls having enhanced visibility properties
27 over the prior art.

28

29 The invention also provides a method of dyeing
30 material which produces an Ultra High Visibility

1 (UHV) felt which mitigates shortfalls of previously
2 available dyed felts.

3

4 More particularly, the invention provides a method of
5 colouring fabric material (particularly fabric
6 material which is suitable for use in sports ball
7 manufacture) which method comprises contacting said
8 fabric material with a bleaching agent prior to or
9 simultaneously with contacting said fabric material
10 with a dyestuff providing said colour. The term
11 "fabric material" includes both piece goods and also
12 fibres in loose form.

13

14 The present invention is based on the fact that the
15 felt used to produce tennis balls typically has a
16 significant wool content (usually 40% or higher).
17 However, the peak reflectance of natural wool fibre
18 in the yellow area of the spectrum is typically
19 around 75% due to the natural yellowish-tinge in even
20 the whitest wool. By means of comparison, titanium
21 dioxide treated nylon would typically have a 90%
22 reflectance. We have found that the naturally low
23 reflectance of wool limits the reflectance achievable
24 even with a fluorescent dye.

25

26 The need to bleach a yellowish-fibre (natural wool)
27 prior to or during dyeing that fibre yellow appears
28 counter-intuitive, but we have found that the
29 performance of the dye applied is greatly enhanced by
30 this step.

31

1 Preferably the material to be dyed is made of a
2 mixture of fibres of different types, for example, a
3 mixture of wool and synthetic (e.g. polyamide or
4 polyester) fibres. Preferred synthetic fibres are
5 polyamide fibres, for example Nylon 6,6 or Nylon 6.
6 We have found Nylon 6,6 to be most suitable. One or
7 more different synthetic fibres may be present in the
8 fabrics material.

9
10 The proportions of wool and synthetic fibres may vary
11 according to the consumer's requirements on cost and
12 performance of the fabric material. For woven
13 fabrics, a wool content of at least 20% (usually 25%)
14 by weight of weft yarn is required.

15
16 We have found that better quality fabric material is
17 achieved with increased wool content - for example
18 30% or higher by weight of weft yarn. Typically a
19 wool content of 40% or above, for example 50% or 60%,
20 by weight of weft yarn achieves good results. For
21 woven fabric, the warp yarn will typically be a
22 cotton yarn, but polyester or polyamide (e.g. nylon)
23 could alternatively be used. For non-woven fabrics
24 (e.g. needlefelted fabrics) or knitted fabrics a
25 lower wool content (for example in the range of 20-
26 40% by weight, preferably at least 25%) may be
27 sufficient. By "wool" we include wool-like fibres
28 (e.g. angora, cashmere and mohair) as well as the
29 more typical sheep's wool.

30

1 We have used nylon fibres having a circular cross-
2 section, but synthetic fibres having other cross-
3 sections (e.g. triangular or flattened) are
4 commercially available and may further increase the
5 reflectance achievable.

6
7 It is also preferred that the material is processed
8 as described in piece form. Preferably the fabric is
9 a felt and more particularly a felt suitable for the
10 covering of tennis balls. Since a mixture of fibre
11 types (wool and synthetic) are present in the fabric
12 material, it is recommended to contact the fabric
13 material also with a partitioning agent in order to
14 eliminate or reduce the difference in uptake of the
15 dyestuff between the different types of fibres. The
16 bleaching agent, which is preferably a reduction
17 bleaching agent, whitens the initial colour of at
18 least the wool.

19
20 Preferably the fabric material is treated using a
21 jet-dyeing apparatus and the liquor ratio used to run
22 the machine is in the range between 6:1 and 8:1.

23
24 It is further preferred that the pH is adjusted
25 preferably between 4.2 and 4.5 by using, for example,
26 formic acid. The temperature is then raised to a
27 suitable temperature, for example about 45°C and held
28 for a period of, typically, 3 minutes to be able to
29 check and if necessary adjust the pH.

30

1 A wide range of suitable partitioning agents are
2 available depending for example upon the nature of
3 the material to be treated. However the partitioning
4 agent sold under the Trade Name BASOPAL NA by BASF
5 plc of Cheshire, SK8 6QG, United Kingdom, has
6 demonstrated good results. BASOPAL NA is an
7 alkylarylsulphonate in water and comprises 50-60% by
8 weight of the salt of dodecylbenzenesulphonic and
9 triethanolamine. The concentration of BASOPAL NA
10 recommended is about 0.5 grams per litre of liquor.
11 Alternative portioning agents include THIOTAN RMFN
12 LIQUID (an anionic sulphated fatty acid, pH 7 to 8 at
13 10% dilution) to be used at a concentration of 3.0 to
14 0.1% (o.w.f.); and ERIONAL RF of Ciba Speciality
15 Chemicals Inc, Basle, Switzerland (an anionic
16 condensation product of aromatic sulphonic acids and
17 formaldehyde, pH 3.5 at 5% solution) to be used at a
18 concentration of 0.5 to 6% gram per litre liquor.

19
20 It is further preferred that the bleaching agent and,
21 if appropriate, the partitioning agent be contacted
22 for a reasonable time with the material prior to the
23 dyeing step being executed.

24
25 It is further preferred that the bleaching agent be
26 added simultaneously or quasi-simultaneously with the
27 partitioning agent.

28
29 The bleaching agent preferably used is the one sold
30 under the Trade Name LUFIBROL FW by BASF plc of
31 Cheshire, SK8 6QG, United Kingdom. LUFIBROL FW is an

1 inorganic reducing agent with chelating agents and
2 comprises 30-40% by weight tetrasodium ethylene-
3 diaminetetraacetate and 30-40% by weight disodium
4 disulphite. The amount of LUBRIFOL FW is
5 advantageously about 2% of the weight of fibre.
6 Alternative bleaching agents include LANALBIN BE
7 powder (a non-ionic hydroxylamine derivative, pH 5.6-
8 5.7 at 1 g/litre) to be used at a concentration of
9 1.0 to 4.0% (o.w.f.); and ERIOCLARITE B of Ciba
10 Speciality Chemicals Inc of Basle, Switzerland (an
11 anionic mixture of sodium metabisulphite with the
12 sodium salt of ethylenediamine tetraacetic acid, pH 6
13 at 5% solution) to be used at a concentration of 0.5
14 to 1 g/litre.

15
16 It is further preferred to use a yellow dye, as this
17 colour is highly desirable for the manufacture of
18 tennis balls. The preferred yellow dye which can be
19 used according to the invention is a dye having a
20 colour index number acid yellow 250 and for example
21 the one sold under the Trade Name NYLOMINE FLAVINE C-
22 7G dyestuff by BASF plc, of Cheshire, SK8 6QG, United
23 Kingdom. The dyeing process can be performed
24 according to the recommended practice. A typical
25 method is to add the dyestuff to the material and the
26 liquor according to a recommended concentration and
27 the recommended temperature is then raised and held
28 for some time at this temperature before rinsing.

29
30 The invention also relates to the dyed material
31 obtained according to the method of the invention

1 which is coloured, preferably in yellow, and displays
2 enhanced visibility properties. The invention also
3 relates to the coloured felt itself which displays
4 enhanced visibility properties.

5

6 The invention further relates to the used of coloured
7 material dyed according to the method of the
8 invention in the manufacture of articles such as
9 sporting articles and more specifically tennis balls.

10

11 The present invention provides a fabric material
12 suitable for use in sports ball manufacture, wherein
13 said material includes at least 20% by weight of wool
14 and exhibits the following characteristics:

15

16 a) for a coloured (non-white) fabric material:

17

18 i) a chroma value of 100 or more;

19 ii) a lightness value of 95 or more; and

20 iii) a reflectance value of 120 or more, or

21

22 b) for a white fabric material:

23

24 i) a chroma value of 14 or less;

25 ii) a lightness value of 85 or more; and

26 iii) a reflectance value of 100 or more.

27

28 Desirably, the fabric material includes at least 30%
29 or more, preferably 40% or more, by weight of wool.

30 It may be desirable to use over 45% by weight of wool
31 and in certain high quality fabric materials 50% by

1 weight of wool, or even 60% by weight of wool (e.g.
2 65% by weight of wool or even up to 70% by weight of
3 wool) may be employed.

4

5 For a coloured (non-white) fabric material the chroma
6 value may be higher than 100 (for example 102 or
7 more, preferably 105 or more) and, generally, a high
8 chroma value is desirable provided that the minimum
9 lightness and reflectance values given above for a
10 coloured (non-white) fabric material are maintained.
11 We have achieved a chroma value of over 110,
12 specifically a value of 113.4.

13

14 Likewise, for a coloured (non-white) fabric material
15 a lightness value of greater than 95 is desirable
16 (for example of 96 or more, or even 97 or more)
17 provided that the minimum chroma and reflectance
18 values given above for a coloured (non-white) fabric
19 material are also maintained.

20

21 Similarly, for a coloured (non-white) fabric material
22 a reflectance value of over 120 (for example 125 or
23 more, preferably 128 or more) is desirable provided
24 that the minimum lightness and chroma values given
25 above for a coloured (non-white) fabric material are
26 also maintained. We have achieved a reflectance
27 value of over 129, specifically a value of 129.9.

28

29 In a preferred embodiment, the coloured (non-white)
30 fabric material according to the present invention
31 exhibits the following characteristics:

1 i) a chroma value of 105 or more (preferably 110 or
2 more);

3

4 ii) a lightness value of 96 or more (preferably 97
5 or more); and

6

7 iii) a reflectance value of 125 or more (preferably
8 128 or more).

9

10 For a white fabric material, the chroma value is
11 desirably lower than 10 (for example is 8 or less,
12 preferably is 5 or less) and, generally, a low chroma
13 value (indicating absence of colour) is desirable
14 provided that the minimum lightness and reflectance
15 values given above for a white fabric material are
16 maintained.

17

18 Likewise, for a white fabric material a lightness
19 value of greater than 85 is desirable (for example of
20 88 or more, 89 or more, or 90 or more) provided that
21 the maximum chroma value and minimum reflectance
22 value given above for a white fabric material are
23 maintained.

24

25 Similarly, for a white fabric material, a reflectance
26 value of over 100 (for example 102 or more, 105 or
27 more or 106 or more) is desirable provided that the
28 maximum chroma value and minimum reflectance value
29 given above for a white fabric material are
30 maintained.

31

1 In a preferred embodiment, the white fabric material
2 according to the present invention exhibits the
3 following characteristics:

- 4
- 5 i) a chroma value of 8 or less (preferably 5 or
6 less);
 - 7
 - 8 ii) a lightness value of 92 or more (preferably 93
9 or more); and
 - 10
 - 11 iii) a reflectance value of 85 or more (preferably 90
12 or more).
 - 13

14 The present invention further provides a sports ball
15 having a fabric material surface (for example a
16 tennis ball) wherein said sports ball is manufactured
17 using a fabric material as defined above.

18

19 In a further aspect, the present invention provides a
20 sports ball having a fabric material outer surface
21 (for example a tennis ball) wherein said fabric
22 material forming said outer surface includes at least
23 20% by weight of wool and exhibits the following
24 characteristics:

25

26 a) for a coloured (non-white) fabric material:

- 27
- 28 i) a chroma value of 100 or more;
 - 29 ii) a lightness value of 95 or more; and
 - 30 iii) a reflectance value of 120 or more, or

31

1 b) for a white fabric material:

- 2
- 3 i) a chroma value of 10 or less;
- 4 ii) a lightness value of 90 or more; and
- 5 iii) a reflectance value of 80 or more.
- 6

7 Desirably, the fabric material includes at least 30%

8 or more, preferably 40% or more, by weight of wool.

9 It may be desirable to use over 45% by weight of wool

10 and in certain high quality fabric materials 50% by

11 weight of wool, or even 60% by weight of wool (e.g.

12 65% by weight of wool or even up to 70% by weight of

13 wool) may be employed.

14

15 For a coloured (non-white) fabric material the chroma

16 value may be higher than 100 (for example 102 or

17 more, preferably 105 or more) and, generally, a high

18 chroma value is desirable provided that the minimum

19 lightness and reflectance values given above for a

20 coloured (non-white) fabric material are maintained.

21 We have achieved a chroma value of over 110,

22 specifically a value of 113.4.

23

24 Likewise, for a coloured (non-white) fabric material

25 a lightness value of greater than 95 is desirable

26 (for example of 96 or more, or even 97 or more)

27 provided that the minimum chroma and reflectance

28 values given above for a coloured (non-white) fabric

29 material are also maintained.

30

1 Similarly, for a coloured (non-white) fabric material
2 a reflectance value of over 120 (for example 125 or
3 more, preferably 128 or more) is desirable provided
4 that the minimum lightness and chroma values given
5 above for a coloured (non-white) fabric material are
6 also maintained. We have achieved a reflectance
7 value of over 129, specifically a value of 129.9.

8

9 In a preferred embodiment, the coloured (non-white)
10 fabric material according to the present invention
11 exhibits the following characteristics:

12

13 i) a chroma value of 105 or more (preferably 110 or
14 more);

15

16 ii) a lightness value of 96 or more (preferably 97
17 or more); and

18

19 iii) a reflectance value of 125 or more (preferably
20 128 or more).

21

22 For a white fabric material, the chroma value is
23 desirably lower than 10 (for example is 8 or less,
24 preferably is 5 or less) and, generally, a low chroma
25 value (indicating absence of colour) is desirable
26 provided that the minimum lightness and reflectance
27 values given above for a white fabric material are
28 maintained.

29 Likewise, for a white fabric material a lightness
30 value of greater than 90 is desirable (for example of
31 92 or more, 93 or more, or 94 or more) provided that

1 the maximum chroma value and minimum reflectance
2 value given above for a white fabric material are
3 maintained.

4

5 Similarly, for a white fabric material, a reflectance
6 value of over 80 (for example 85 or more, 90 or more
7 or 95 or more) is desirable provided that the maximum
8 chroma value and minimum reflectance value given
9 above for a white fabric material are maintained.

10

11 In a preferred embodiment, the white fabric material
12 according to the present invention exhibits the
13 following characteristics:

14

15 i) a chroma value of 8 or less (preferably 5 or
16 less);

17

18 ii) a lightness value of 92 or more (preferably 93
19 or more); and

20

21 iii) a reflectance value of 85 or more (preferably 90
22 or more).

23

24 The invention as described above with reference to
25 coloured (non-white) fabric material (both in respect
26 of the fabric material per se and in respect of the
27 sports ball having a fabric material outer surface)
28 preferably refers to a yellow fabric material.
29 References to "yellow" refer to any non-white fabric
30 material which is acceptable to the International
31 Tennis Federation (I.T.F.) (since yellow is an

1 accepted coloration of tennis ball according to the
2 I.T.F.). However, this is not exclusive, and other
3 coloured fabric materials (for example pink, green,
4 blue, etc) are also encompassed.

5

6 A comparison of the peak reflectance level, chroma,
7 hue and lightness for the fabric according to the
8 invention (U.H.V. F. Yell.) with commercially
9 available alternatives is given in Table 1.

10

11 Table 1

12

Product	Peak Reflectance Level	Chroma (Saturation)	Hue	Lightness
Natural White Tennis Ball Felt	78.46	8.9	92.4	87.8
Milliken Standard F. Yell	122.4	98.2	108.8	96.5
Milliken High Viz. F. Yell.	119.8	112.0	101.3	94.2
U.H.V. F. Yell	129.9	113.4	104.7	97.9
Tretorn TXT Ball	113.1	100.9	104.5	93.6
Pro Penn Ball	124.4	95.8	108.1	95.7

13 The present invention will be now further described
14 with reference to the following, non-limiting
15 example.

16

17 **Figure 1** shows the reflectance curves of two prior
18 art felts in ball form (Nos 2 & 3) compared with the
19 ultra high visibility (UHV) felt in fabric form (No
20 1) of the invention.

1 **Figure 2** shows the reflectance curves of two other
2 felts (Nos 4 & 5) produced by the Applicant and
3 compared with the UHV felt (No 1) of the invention,
4 all in fabric form.

5

6 **Figure 3** shows the same data as Figure 2 but the data
7 used to produce the curves are generated by the
8 International Tennis Federation on their
9 spectrophotometer.

10

11 **Figure 4** shows the saturation (chroma) of the UHV
12 felt (No 1) of the invention compared with the four
13 prior art felts (Nos 2 to 5) used in Figures 1 to 3.

14

15 **Figure 5** shows the lightness of the same five felts
16 used in Figure 4.

17

18 **Figure 6** is an attempt to illustrate the position on
19 the colour circle by both chroma and hue of the five
20 samples used in Figures 1 to 3, 4 or 5.

21

22

23

24

25

26

1 **Example 1**

2 **Production of an ultra high visibility yellow felt**
3 **according to the method of the invention**

4

5 The felt used in this example is a fabric material
6 having an back surface made mainly in cotton and a
7 face side made of a wool and polyamide fibre felt
8 (the face side of the fabric forms the external face
9 of the ball). Only the face surface made of wool and
10 polyamide felt needs to be coloured. Wool and
11 polyamide are present in the weft in a ratio of about
12 60:40 with respect to the weight of wool and
13 polyamide fibres. The amount of cotton fibres in the
14 material represents about 15 % of the total weight of
15 the fabric material.

16

17 The felt is dyed using acid dyes in piece form using
18 a Softflow jet dyeing machine which is run at a
19 liquor ratio of between 6:1 and 8:1. The liquor is
20 the liquid in which the material is wetted before
21 the addition of the dyestuff. In most cases and in
22 particular in this example the liquor is water.

23

24 The dyeing method used in this example is as
25 follows:-

- 26 - The felt is entered into the machine cold and
27 the liquor ratio as indicated above;
28 - The pH is adjusted between 4.2 and 4.5 with
29 formic acid;
30 - The temperature is raised to 45°C and held for
31 3 minutes whilst checking pH;

- 0.5 grams per litre of BASOPAL NA (BASF) and 2% by weight of fibre of Lufibrol FW (BASF) are added through the dosing system; and
- the machine is run for 5 minutes at 45°C.

The following dyeing method is then applied:

- 1.6% by weight of fibres of NYLOMINE FLAVINE C-7G dyestuff is added through the dosing system during a period of 2 minutes;
- the temperature is raised at a rate of 1.8°C per minute to 95°C and the machine is run for 30 minutes at this temperature;
- the temperature is decreased to 40°C at a rate of 2.5°C per minute; and
- the felt is rinsed twice with fresh water and unloaded from the machine.

Comparative data

The colour characteristics of the felt dyed according to the above described method are shown in Figures 1 to 6. Except for Figure 3, all data were measured by the Applicant using CIE (Commission Internationale d'Eclairage) CIELAB formula at a 10 degree reflectance angle using standard D65 illuminant.

Figure 1 shows reflectance curves of an UHV yellow felt made according the method described in Example 1 and of two competing felts in the form of tennis balls produced respectively for the companies Tretorn Sport and Penn Racquet Sports under the Trade Names TRETORN TXT and PRO PENN. The felts used to cover

1 these balls are produced by Textech Industries. We
2 have found little difference in the
3 spectrophotometric measurements made between a fabric
4 in sheet form and the same fabric when in the form of
5 completed tennis balls.

6 Figure 2 shows reflectance curves of the UHV felt
7 used in Figure 1 and of two other yellow felts, a
8 "standard" one and an "high visibility" one, both
9 produced by the company Milliken (Woollen Speciality
10 Products) under the respective Trade Names PLAYNE'S
11 14 and PLAYNE'S 45. These felts are used in the
12 manufacture of tennis balls such as the ones sold
13 under the Trade Names DUNLOP FORT (standard) and
14 SLAZENGER WIMBLEDON (high visibility).

15

16 Figure 3 shows the same data as Figure 2 but the data
17 used to produce the curves are generated by the
18 International Tennis Federation (ITF) on their
19 spectrophotometer. This independent measurement shows
20 good correlation with the Applicant's own data.

21

22 Figures 4 and 5 show respectively the chroma and the
23 lightness of the five tested felts.

24

25 Figure 6 shows a graph displaying the combination of
26 both chroma and hue performances of the five tested
27 felts.

28

29 As can be seen from Figures 1 to 6, the colour of the
30 felt of this example of the invention demonstrates
31 superior characteristics in all areas (i.e. chroma,

1 hue lightness and reflectance). The performances,
2 when compared to the closest prior art (i.e. the High
3 Visibility felt manufacture by Milliken), are
4 especially better for lightness and reflectance.

5
6 Figures 2 to 4 & 5 show that the high visibility felt
7 has a higher level of saturation (Chroma) but
8 actually has a slight reduction in peak reflectance
9 and in lightness when compared to the standard colour
10 felt. This disadvantage does not exist with the
11 colour of the UHV felt.

12
13 Thus, the UHV felt of the this example of the
14 invention can be used for the manufacture of yellow
15 tennis balls of improved colour properties, which is
16 obviously highly desirable to tennis players. Such
17 improved properties permit, during a game, a more
18 easy and rapid catch (visualisation) of the incoming
19 moving ball by the tennis player and thus a quicker
20 reaction and positioning of the player with respect
21 the ball.

22
23 The method and the product thus produced according to
24 the invention may be used for other purposes than
25 covering tennis balls. The high visibility of colour
26 material of the invention could also be used for
27 producing other items than tennis balls, especially
28 those where high visibility is important (for example
29 footballs - especially for indoor use - basketballs
30 and volleyballs).

31

1 Alternative dyeing technologies may be used, and
2 specific mention may be made of the following:

3

4 1. Winch beck

5

6 Winch beck dyeing is an alternative technology for
7 dyeing piece goods and pre-dates the softflow jet-
8 dyeing apparatus. Whilst the dyeing method is
9 essentially the same as for jet-dyeing the liquor
10 ratio would be higher, normally 20:1 to 25:1.

11

12 In simple terms, this is a vertical stainless steel
13 tank; the top half of one side lifts up and down for
14 access and the top is vented. A large roller known
15 as a winch is contained within the top section.
16 There is a heating coil in the bottom section.

17

18 The tank is partially filled with water and the cloth
19 is then passed over the winch roller, through the
20 water and then back out of the machine. The two ends
21 of the cloth are sewn together to make an endless
22 rope. The winch is driven to continually rotate the
23 rope through the water.

24

25 Dyes and chemicals are pre-dissolved and then added
26 to the water. Steam is passed through the heating
27 coil to raise the bath temperature to 98°C. This
28 temperature is held for 30-45 minutes, after which
29 the tank is cooled by filling with cold water and
30 then draining. This is repeated until a safe

1 handling temperature is achieved after which the
2 cloth is removed.

3

4 Products used in the bath:

5

6 Fluorescent yellow dyestuff - colouring material.

7 Glauber salts - acts as a levelling agent.

8 Formic acid - to lower the pH making the cloth more
9 attractive to dyestuff.

10

11 2. Loose stock machine

12

13 This is a circular stainless steel tank (or vat),
14 from 1 metre to 3 metres diameter, which is partially
15 filled with water. The material, in the form of
16 loose wool and/or nylon fibres, which have been pre-
17 washed is loaded into a cage. This cage then has a
18 lid attached and is placed inside the outer tank.
19 Dyestuff and chemicals are pre-dissolved inside a
20 header tank and then pumped into the tank and through
21 the stock in the cage.

22

23 The temperature of the vat is raised to 98°C and held
24 for 30-45 minutes. The dye liquor is drained and
25 fresh cold water pumped through to rinse and cool the
26 loose stock.

27

28 The products used are the same as for winch dyeing.

29

30 After dyeing the fibres are processed into fabric
31 form.

1 3. Package dyeing

2

3 Yarn is wound onto a stainless-steel cylinder which
4 is perforated, allowing the dyeing liquor to be
5 pumped through the yarn package from inside to out
6 and vice versa. The yarn package is loaded into a
7 circular, stainless steel tank and then pre-dissolved
8 dyes and chemicals are pumped in.

9

10 The temperature of the liquor is raised to 98°C by a
11 steam heating coil. This temperature is maintained
12 for approximately 1 hour. The packages are then
13 rinsed with cool water to cool the bath and remove
14 residual dyestuff. The batch is left to drain and
15 then removed from the vessel.

16

17 Products used are the same as for winch dyeing.

Tennis Felt Reflectance Chart Spectrophotometer Evaluation of Competing Products

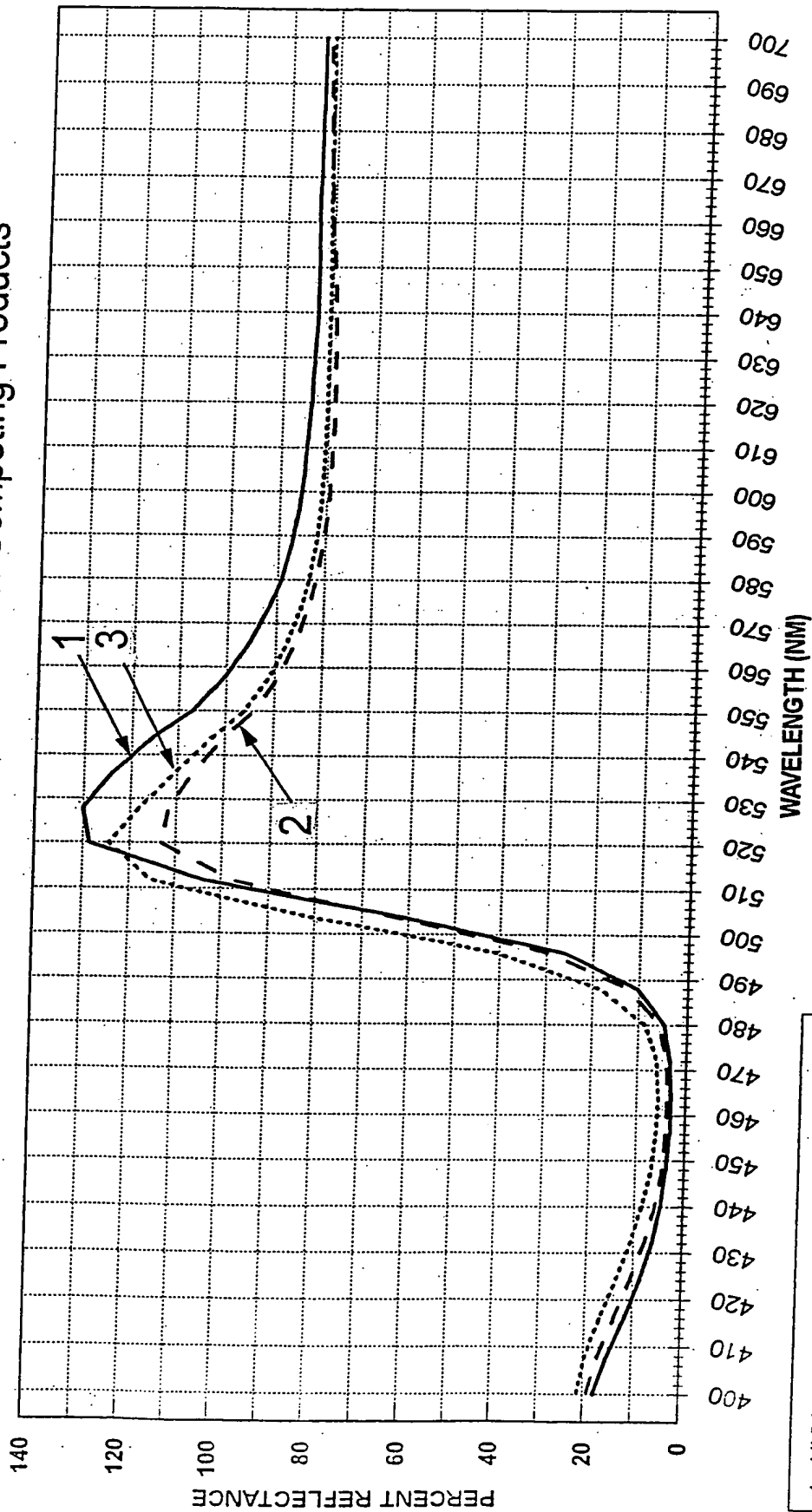


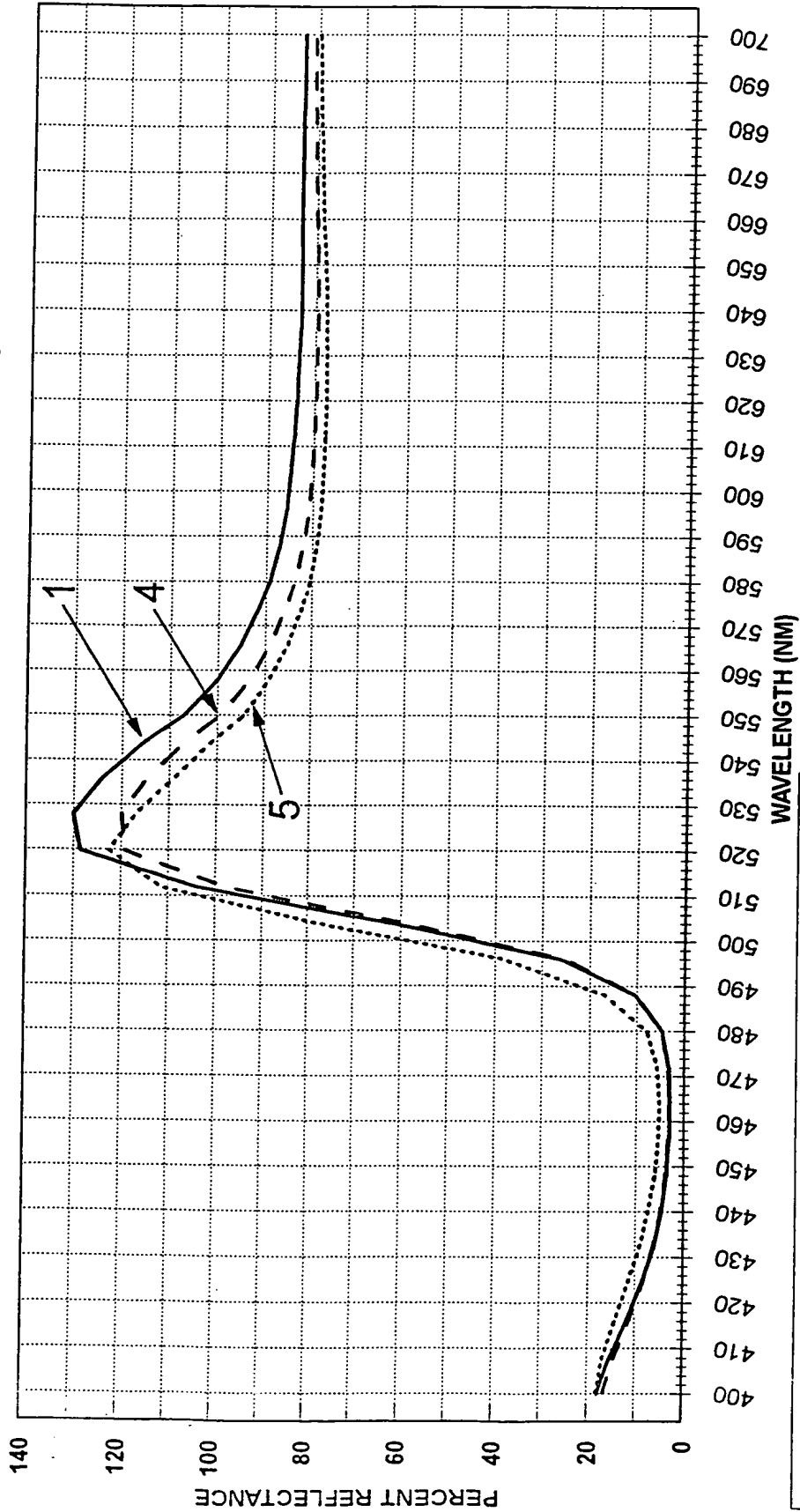
FIGURE 1

- 1 - UHV FY New Milliken development colour
- 2 - Tretorn TXT - Tretorn TXT ball from market
- 3 - Pro Penn - Pro Penn ball from market

UHV FY
1.
Tretorn TXT
2.
Pro Penn
3.

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Milliken Tennis Felt Reflectance Chart Comparative Spectrophotometer Evaluation by Milliken

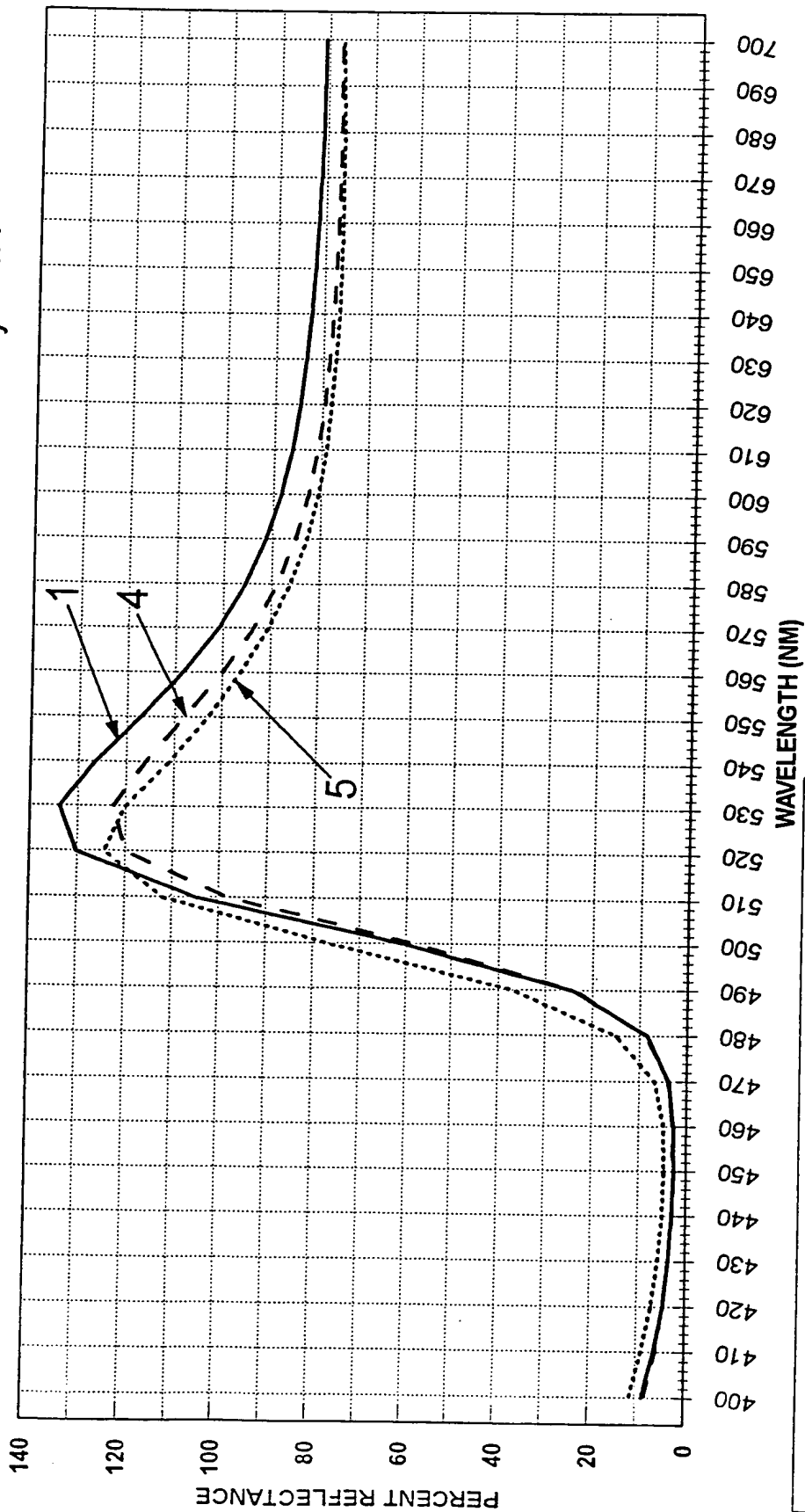


5 - Std.FY - Current standard product
4 - Hi.Viz.FY - High Visibility colour used on Slazenger Wimbledon ball
1 - UHV FY - New development colour

FIGURE 2

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Milliken Tennis Felt Reflectance Chart Comparative Spectrophotometer Evaluation by I.T.F.



- 5 - Std.F/Y - Current standard product
- 4 - Hi. Viz. F/Y - High Visibility colour used on Slazenger Wimbledon ball
- 1 - UHV F/Y - New development colour

FIGURE 3

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Tennis Felt Comparison Spectrophotometer Evaluation of Competing Products Chroma (Saturation)

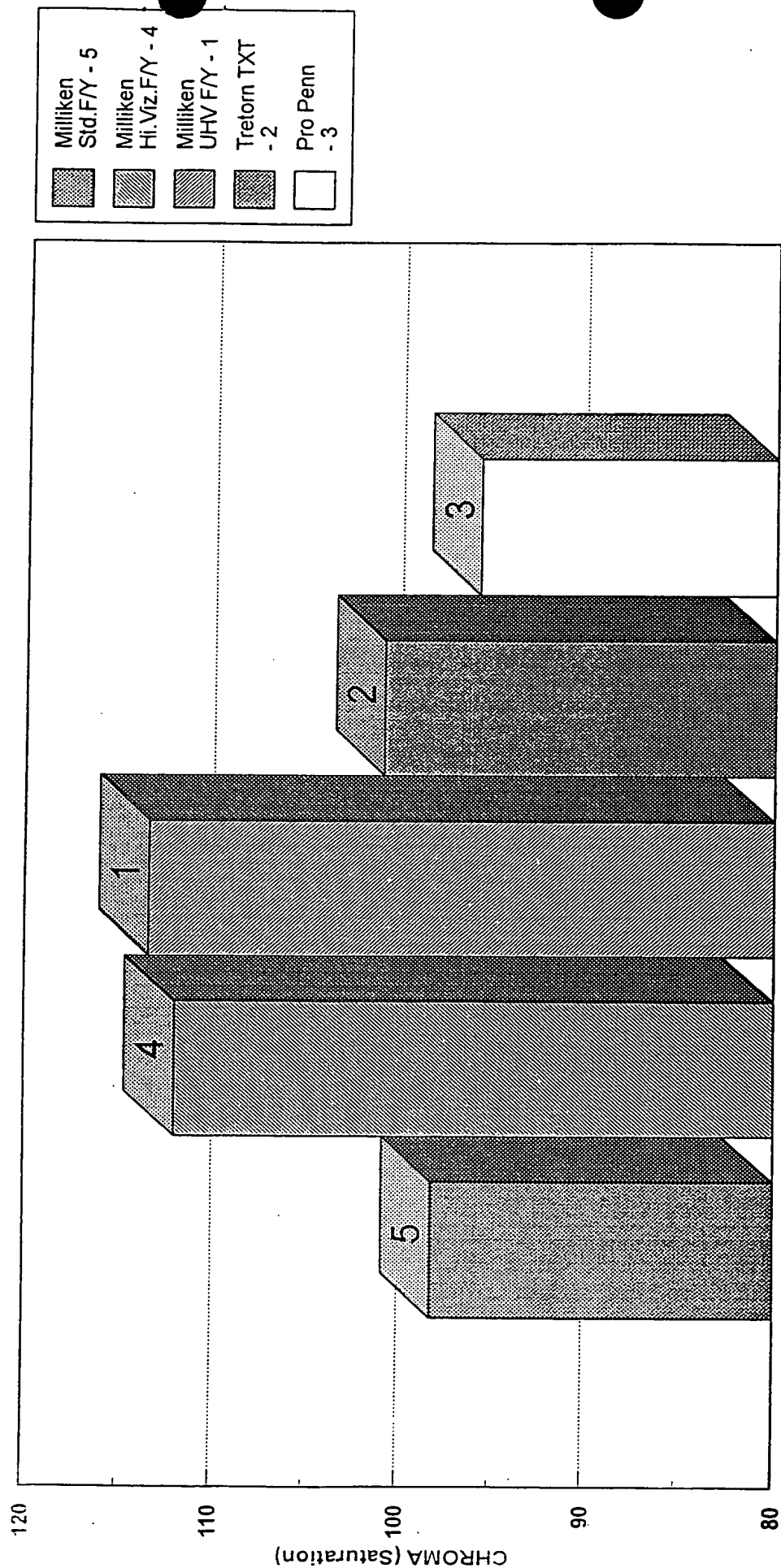


FIGURE 4

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Tennis Felt Comparison Spectrophotometer Evaluation of Competing Products Lightness

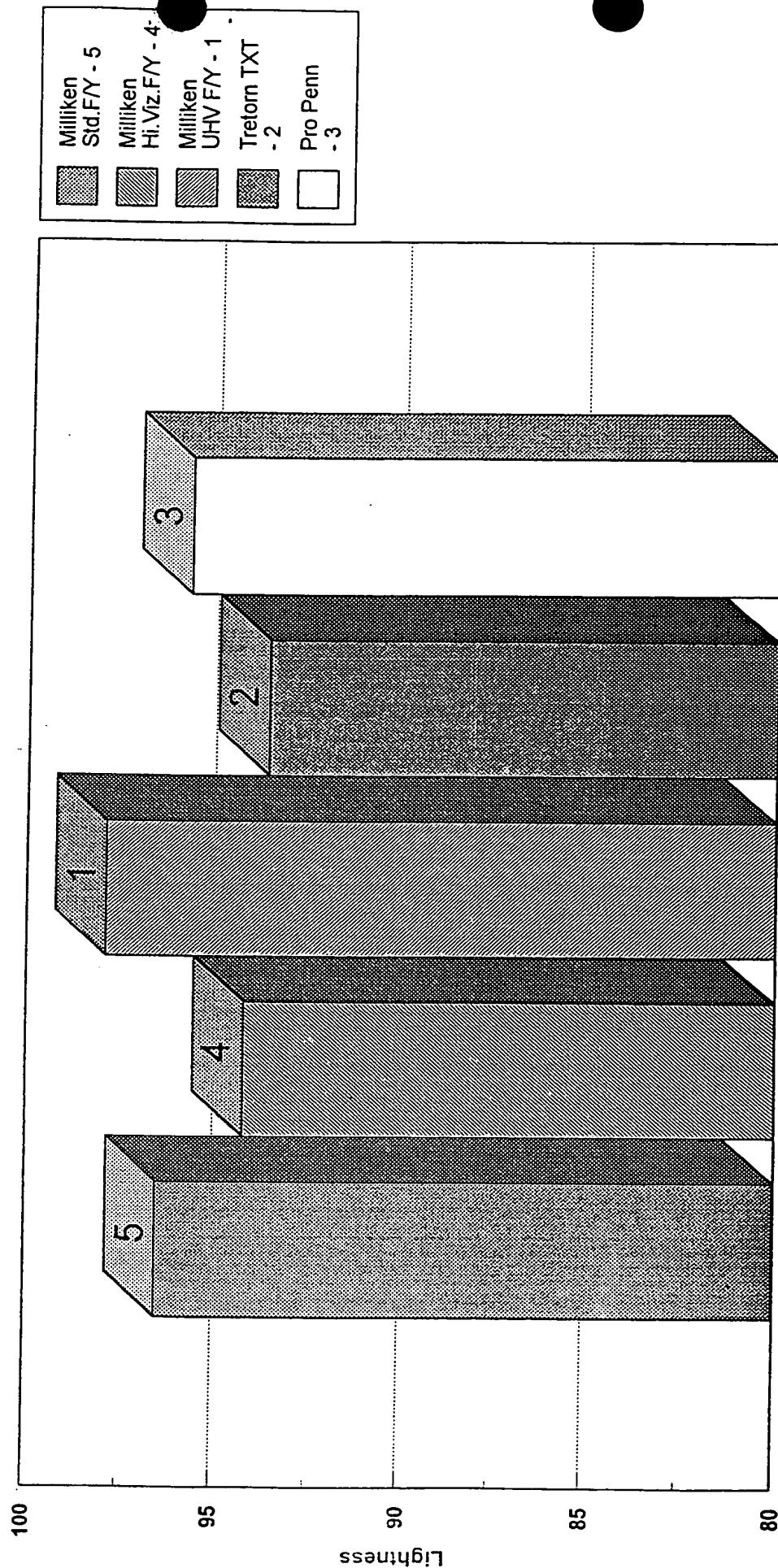


FIGURE 5

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PLOT TO SHOW COLOUR COMPARISON OF TENNIS BALL FELT (CHROMA & HUE)

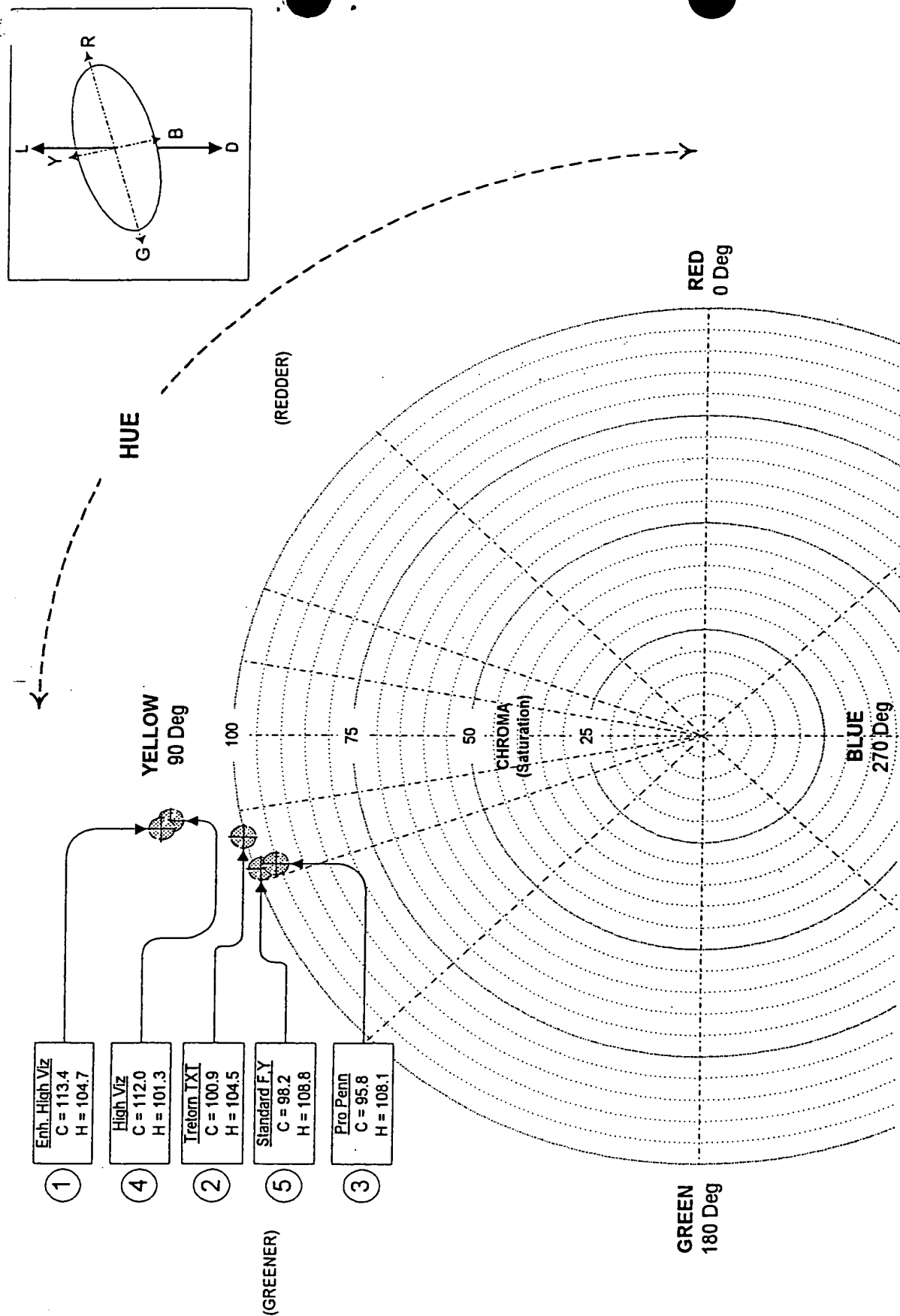


FIGURE 6

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Murgitoyd & Co

28/6/2000.

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